BANGALORE ELECTRICITY SUPPLY COMPANY LIMITED

(Wholly owned by Government of Karnataka Undertaking)

TECHNICAL SPECIFICATIONS FOR PRESTRESSED CEMENT CONCRETE POLES
(9Mtr PSCC Pole with working Load of 300Kg)
(PRETENSIONED TYPE)

1. Scope

a) This specification covers the manufacture of Pre-stressed cement concrete poles as per specifications No IS: 1343 and 1678 of 1978 and as amended up to date and including all other relevant standards.

2. Designs and Drawings

a) The poles shall be manufactured in accordance with the BESCOM design & drawing, enclosed. The poles are designed to withstand the working loads of **300Kg for 9 Mtr** long PSCC poles, acting at 0.6 M from top of the poles and the planting depth of the poles being 1.5M below ground level.

3. Material: - All the materials procured by the contractor for manufacture of poles shall comply with standard specifications of BIS codes.

a) **HT Steel**: - Shall be 4mm HT Steel with guaranteed ultimate tensile strength of 175 Kg/Sq mm as per IS 6003/1970. Test certificates shall be verified by the engineer and approved before commencement of the work. In the absence of test reports three samples shall be selected in the presence of the engineer and tests conducted in stock tested periodically at the cost of the tenderer.

b) **53 grade Cement**:- The cement used shall conform to IS 269-1976 (Specification for ordinary and low heat Portland cement for the following minimum requirements)

I. Initial setting time not less than 30 minutes.
II. Final setting time not less than 600 minutes.
III. The minimum compressive strength of standard mortar cube with graded sand as per IS: 650-1966(1st version) at 7 days shall be 200kg/Sqmm.
IV. 53 grade cement manufactured by standard company shall be used in the work.
V. As far as possible, the cement shall be obtained from one source to minimize variations in the quality. A test certificate shall cover each consignment. Each consignment of cement shall be stacked separately and shall be clearly identified.
VI. Before using a particular batch of cement, a minimum 3 trial cubes shall be made with aggregate grading as followed for the approved design mix and the average compressive strength results at 7 days shall be determined to assess the suitability of the cement.

c) **GI Wire**: The contractor has to procure No.8 GI wire for earthing of PSCC Pole.

d) **Aggregate** :

I. For adequate control of concrete, the coarse aggregates shall be classified into two sizes, and the requisite proportions of each size shall be used in making the concrete. Each size of graded aggregates shall be stocked in different storage bins or stock piles and shall be mixed only after the quantity required for each size has been separately weighed. The storage bins or stock piles shall be under cover protected from weather.

II. The quality of the aggregate shall conform to IS 383-1970.

e) Sand :

I. The fine aggregate i.e Sand used for the work shall comply with IS 383-1970.

f) **Water**: Potable water shall be used for manufacture of poles.

4. <u>Concrete</u>:

a) The Concrete shall be 'Controlled' quality with the nominal maximum size of aggregates limited to 20mm.

b) The water cement ratio should be 0.4. The moisture content in fine aggregates shall be determined daily and the required quantities of water to be added in the concrete mix shall be determined.

5. <u>Design Mix:</u>

a) The design mix 53 grade cement: Sand: Metal for manufacture of PSCC Poles shall be in Proportion(1:1.44:2.70)

b) The strength of the concrete shall be as below:

I. Comprehensive strength at 28 days: The work test cube crushing strength of the concrete shall not be less than 400 Kg/Sq.Cm. The specified strength of the mix to be used in the works is 400Kg/Sq. Cm. The designed target strength of the mix is 466 Kg/Sq.Cm.

II. Compressive strength at transfer: The works cube compressive strength at transfer of prestress shall not be less than 200Kg/ Sq.Cm under conventional water curing process.

c) A minimum of 6 test specimens of 15Cms cubes shall determine the compressive strength of concrete at each stage. The compressive strength stipulated above shall be based on the lowest cube test result of the 6 test specimens. This shall, however, be relaxed to the second lowest cube test result in case the number of test specimens is increased to a minimum of 12 at each stage.

6. Method of Manufacture of Poles;-

a) Moulds

I. Moulds shall be of steel and shall be of rigid construction to prevent distortion. The moulds shall not allow any leakage of cement grout in casting. The holes in the end plates, for the H.T. wires shall be accurately drilled by Jig to ensure interchangeability.

II. Before the wires are stretched and tensioned it should be ascertained that all the moulds are thoroughly cleaned from grit and it should be fitted rigidly and waste oil applied inside the moulds for easy separation of poles from the moulds.

III. In the case of the long line method of manufacture the casting bed shall have provision to ensure correct alignment of the moulds. The moulds shall be free to move/slide along the line to permit transfer of pre-stress force along the line without restraint.

b) Stretching of wires:

1) In the stretching of the H T steel Wires, the tensile force in each 4mm dia HT wire should 1760Kgs. The anchoring of the stretched wires shall be such that during manufacture and until the wires are released, no slipping occurs.
2) The tensioning of pre-stressing steel shall be carried out in a manner that will induce a smooth and even rate of increase of stress in the wires.
3) Tensioning shall be done by means of a device either with chain pully block or power operated hoist with the help of dynamometer.
4) The HT steel wires do not come in contact with waste oil Mould.
5) Alignment and levels of the pedestal foundations are in order after stretching Deformity in moulds is not permitted.
6) All Components of moulds like side channels and bottom plates should be assembled and tightened and bought to the true alignment.

c) Earthing :-

i. Earthing shall be provided by having a length of 8.00 SWG GI Wire embedded in concrete during manufacture and the ends in wire left projecting from the pole to a length of 100 mm at 250 mm from top and 150 mm below ground level.

ii. The earth wire shall not be allowed coming into contact with pre-stressing wires.

d) Mixing and consolidation of concrete :-

i. Provision shall be made to measure the quantities of cement, fine and coarse aggregates by weight only. The accuracy of the measuring equipment shall be maintained in a clean, serviceable condition and its accuracy checked regularly. Volume batching is not permissible. Mixing of concrete shall be done in a mixer only and hand mixing is not allowed.

ii. Mixing and placing of concrete shall as possible be avoided during the extreme temperature in summer and winter. The concreting shall commence within one hour of stretching of the wires, failing which the high tensile steel wires shall be checked and re-tensioned if necessary.

iii. The manufacture of poles shall be done under suitable cover and the poles shall not be cast in the open.

iv. The concrete shall be thoroughly mixed and consolidated by means of high frequency vibrators. The extent of vibration required for obtaining full consolidation should be determined on actual field trials.

v. The freshly cast poles shall be protected during the first stage of hardening from the harmful effects of sunshine, dry winds, cold and rains.

e) De-tensioning of wires:-

i. The anchoring system shall provide a device for gradual de-tensioning of the wires. No back pulling of the wires shall be permitted in the gradual de-tensioning device. Flame cuttings of the wires before release of the full tension shall be employed to cut the wires.
ii. De- tensioning of HT wire shall be done after 72 hours only.

Curing

iii. The curing of poles shall be carried out by covering the poles with empty gunny bags after 2 to 3 hours of concreting and concreting and constantly wetted for 72 hours prior to de-tensioning.
iv. After de-tensioning the poles shall in the cured in the ponds for 10 days. The poles during this period of curing shall not be allowed to dry out at any cost.

7. Supervision:

a. A competent and qualified person shall be employed by the manufacturer whose duty will be to supervise at all stages of the placement of the concrete.
b. All tests on materials the making and testing of cubes, the maintenance and calibration of all mixing and measuring plants and gauges shall be carried out under his direct supervision.
c. He shall also maintain a direct record of the quantities, proportions and source of supply of aggregates used, nature and duration of curing actually done, the result of internal as well as external tests etc these records shall be kept available for scrutiny by the engineer at all times.
d. The name of the competent person shall be intimated to the engineer before commencing manufacture.

8. Tolerances:

a. The tolerance on overall length of he poles shall be +15 cm
b. The tolerance on cross sectional dimensions shall be +3mm.
c. The tolerance on uprightness of the pole shall be 0.5 percent.

9. Finish:-

1. All poles shall be free from surface defects including hair cracks. The surface of the poles in contact with the steel moulds shall be smooth and regular in shape, and as far as possible, be free from pores, water retaining pockets or honey combing formations shall not be admissible.
2. The ends of the pre-stressing wires shall be cut as close to the surface of the poles as possible and in any case, shall not project more than 3 mm.
3. The ends of high tensile steel wires shall be given two coats of suitable epoxy or anticorrosive paints approved by the engineer.

10. Stacking in lots:-

1. After the poles have been checked both dimensionally and from the point of view of finish they shall be stored at a convenient place in lots, each lot comprising of all pole cast together and de-tensioned simultaneously in one long line(of single or multiple moulds).
2. The poles shall be stacked on levelled and consolidated grounds, on one another upto a height corresponding to not more than 15 poles. Each pole shall be separated from the other vertically by wooden battens of size 50x50mm to ensure that the poles are stacked evenly without damages.

11. Inspection and Testing:-

a) Inspection:-

i. The contractor shall supply at his expense all the poles required for tests and for retest. Samples of materials and all labour, machines, tools, gauges, apparatus, forms of tests reports etc., and all things which may be necessary or required by the engineer for carrying out any or all of the checks and tests mentioned in the specifications and shall tender all reasonable assistance in making such checks and tests.

ii. One pole for every 200 poles shall invariably be tested to destruction.

iii. All pressure gauges and measuring dials on the compression test machines, Pre-tensioning equipment, static bending test machine, weight batching machine shall be got checked and calibrated regularity as directed by the engineer by an independent agency and the adjustment certificates shall be furnished to the engineer. The frequency of calibration of different gauges is given below.

Frequency for calibration of different gauges and testing equipment

1.	Cube testing machine	Once in six months
2.	Weight	Every week or after casting 500 poles whichever is earlier
3.	Pole testing machine	After testing 250 poles on machine jack or three months whichever is earlier
4.	Tensioning Jack	Every three months or after tensioning 5000 poles whichever is earlier
5.	Dimensional guages	three months or after checking 5000 poles whichever is earlier

iv. The cracking moment shall be that moment at which when a load is applied on the pole for testing as specified below, the pole just begins to develop hair line crack(s) barely perceptible to the naked eye of a length of 15 mm and above. The failure moment shall be the moment corresponding to that load beyond which a further load increment shall be no longer possible due to the progressive deflection of pole.

v. The loading arrangements for conducting the static bending strength tests shall be with the load applied at 6.0 m from top of the pole. Bottom

supports shall be carefully fixed to valid un-even levelling and the bearing surfaces shall be proper to ensure uniform line contact with concrete surface. Any roughness and unevenness of concrete in the tearing area shall be made up with plaster of Paris gypsum or suitable rubber packing. The testing shall be done at point of application of load, fixing the pole from the bottom at 1.5 m height.

vi. When testing the concrete poles the formation of the hair cracks shall be carefully observed and the load shall be increased up to the point at which hair cracks just perceptible to the naked eye appear and load noted. The loads shall be increased at the rate of 50 Kgs the interval between two instalments being 1 minute for observing cracking moment and failure moment.

b) Frequency of check and testing :-

1) For each lot of poles, compressive strength tests on concrete both at 28 days and transfer of load shall be carried out on a minimum of 3 cubes each time.
2) The modulus of rupture test of concrete shall be carried out at the rate of one pole per day for the first 1500 poles produced. Thereafter, it will be sufficient if a minimum of one pole is tested for week's production.
3) For the check and test on the poles, the number of poles to be tested and the frequency of testing shall be as follows :
   a) Dimensional checks and surface finish:
      The frequency of dimensional check shall be at the rate of 10% from each lot of pole for dimensions like length, breadth, width where such dimensions depend up on the accuracy of the mould.

   b) Static bending strength:
      In case of lots whose works concrete cubes strength is equal to or more than 400Kg/Sq.mm, the static bending tests shall be carried out at 0.6m from the top of the pole at the rate of one pole fro every 200 poles manufactured.

c) Inspection :-

The BESCOM may carry out inspection at any stage of manufacture. The successful tenderer shall grant free access to the representative of BESCOM at a reasonable time when the works is in progress. Inspection and acceptance of any material under this specification by the purchaser shall not relieve the supplier of his obligation of furnishing by the purchaser shall not relieve the supplier of his obligation of furnishing materials in accordance with the specification and shall not prevent subsequent rejection if the material is found to be defective.

The engineer shall have free access at all times to the works in which the poles are manufactured. They shall be at liberty to inspect the manufacture at any stage and to reject any material or work, not confirming to the terms of this specifications.

d) Check & Tests :-

I. In addition to the control check exercised on the materials and manufacturing process specified in clauses above, the concrete and finished pole shall be subject to the following periodical checks and test.
   a) Compressive strength test of concrete at 28 days.
   b) Compressive strength test of concrete at the time of de-tensioning.
   c) Modulus of rupture test of concrete.
   d) Check for dimensional tolerances and surface finish of poles.
   e) Statistics bearing strength test of poles.

II. Pole to be tested shall be selected at random by the engineer. One hour before the test, the poles shall be given a coat of lime wash in order to make the cracks easily visible. The poles shall be tested as per the Annexure enclosed to this tender.

e) Compressive strength test of concrete:-

i. Test cubes of size 15 CM X 15 CM X 15 CM shall be made and consolidated from the same concrete simultaneously with the poles. The cubes shall be cured along with the poles in the same manner and tested prior to transfer of pre stress, to check that the concrete has developed the requisite minimum compressive strength specified at transfer. The remainder of cumbers shall be cured as specified in IS-456-2000 and tested at the end of 28 days to determine the concrete has attained the minimum strength at transfer.

f) Modulus of rupture test of concrete:-

i. The modulus of rupture test of concrete shall be carried out on concrete poles as specified in IS-516. The results obtained shall be supplied to the engineer for information.

g) Check for dimensional tolerance and finish:-

1) The poles shall be examined visually for finish and free from surface defects. The dimensional tolerances specified, directed by the engineer.

h) Static bending strength test of poles:-

1) The following cracking failure moments of the poles shall be ascertained by recording the corresponding loads.
   a) First crack moment.
   b) Failure moment.